

From the NEUROTEC DEPARTMENT
DIVISION OF PHYSIOTHERAPY
Karolinska Institutet, Stockholm, Sweden

PAIN AND PHYSICAL ACTIVITY IN RHEUMATOID ARTHRITIS

A COGNITIVE APPROACH IN PHYSICAL THERAPY

Stina Lundgren



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To all patients struggling with arthritis

ABSTRACT

A gradual shift towards more active patient involvement has taken place during the past few decades. It is thus important for physical therapists to understand individuals' cognitive appraisals of health states. Patients with rheumatoid arthritis (RA) are frequently referred to physical therapy for treatment of pain and activity limitation. Little is known about how their cognition, i.e. thoughts, feelings, and beliefs about their health, are related to physical therapy evaluation and what the effects of cognitive treatment given by physical therapists are.

The overall aim of the present work was to investigate pain and physical activity in patients with RA, from a physical therapy perspective and a cognitive approach.

The present work comprises four studies: one randomized, controlled study of progressive relaxation training; one methodological study of the measurement properties of a Swedish version of the Multidimensional Health Locus of Control Scales, form C (MHLC-C); and two cross-sectional studies on relations between pain and physical activity on the one hand, and health locus of control, beliefs about relationships between pain and impairment, and fear-avoidance, on the other. A total of 585 patients with RA were recruited from different rheumatology clinics. Assessments were performed with laboratory and clinical tests, rating scales, and questionnaires that were all valid and reliable for patients with RA and/or long-standing pain. A relaxation training program was performed with taped instructions two days a week for ten weeks.

The results indicate that relaxation training improved certain aspects of self-rated health and observed muscle function at post-intervention and at a six-month follow-up, while no effects remained after 12 months. The translated, revised Swedish MHLC-C possessed satisfactory content validity, construct validity, test-retest stability, and internal consistency. High-intensity pain was related, in patients with early RA, to high attribution of health locus of control either to themselves or to doctors; and moderate/high levels of physical activity were related to high internal control. No relations between self-rated health and the MHLC-C sub-scales were found. Among patients with long-standing RA, pain and physical activity were not related to health locus of control, and no relations were found between physical activity and either fear-avoidance beliefs or beliefs about relationships between pain and impairment. However, high pain intensity was strongly related to fear-avoidance beliefs and to beliefs about relationships between pain and impairment in long-standing RA.

In conclusion, the present work provides knowledge about individuals' cognitive appraisals of health states and how a cognitive approach contributes in physical therapy.

SAMMANFATTNING

Under de senaste decennierna har patienterna blivit alltmer delaktiga i sin vård. Det är därför viktigt att sjukgymnaster uppmärksammar och förstår individens kognitiva värderingar av sitt hälsotillstånd. Patienter med reumatoid artrit (RA) remitteras ofta till sjukgymnaster för behandling av smärta och aktivitetsbegränsningar. Hittills är lite känt om sambandet mellan kognitioner, det vill säga tankar, känslor och föreställningar om den egna hälsan, och den sjukgymnastiska utvärderingen och vilka effekter sjukgymnastisk behandling har om kognitiva aspekter integreras.

Det övergripande syftet med det föreliggande arbetet var att undersöka smärta och fysisk aktivitet hos patienter med RA, med ett kognitivt inriktat sjukgymnastiskt perspektiv.

Detta arbete omfattar fyra studier: en randomiserad, kontrollerad studie om progressiv avspänningsträning; en metodologisk studie om mätegenskaperna hos en svensk version av 'the Multidimensional Health Locus of Control Scales, version C' (MHLC-C); och två tvärsnittsstudier om sambandet mellan smärta respektive fysisk aktivitet å ena sidan och var man förlägger kontrollen över sin hälsa, föreställningar om samband mellan smärta och funktionshinder samt rädslundvikande å den andra. Totalt ingick 585 patienter med RA, vilka rekryterades från olika reumatologkliniker. Utvärdering gjordes med laboratorietest, kliniska tester, skattningsskalor samt frågeformulär, vilka samtliga befunnits vara valida och reliabla för patienter med RA och/eller långvarig smärta. Ett program med avspänningsträning genomfördes med bandade instruktioner två dagar per vecka under tio veckor.

Resultaten indikerade att avspänningsträning förbättrade vissa områden av självskattad hälsa och observerad muskelfunktion omedelbart efter träningsperioden och vid sexmånadersuppföljningen, medan inga effekter kvarstod efter 12 månader. Den översatta, reviderade svenska MHLC-C hade tillfredsställande innehållsvaliditet, begreppsvaliditet, test-retest stabilitet samt intern konsistens. Hos patienter med tidig RA var hög smärtintensitet relaterad till hög grad av kontroll över hälsan förlagd antingen till sig själva eller till doktorn och måttlig till hög fysisk aktivitet var relaterad till hög intern kontroll. Inga samband fanns mellan självskattad hälsa och MHLC-C delskalorna. Hos patienter med långvarig RA relaterade varken smärta eller fysisk aktivitet till var man förlade kontrollen över hälsan. Det fanns inte heller någon relation mellan fysisk aktivitet och rädslundvikande eller föreställningar om samband mellan smärta och funktionshinder. Emellertid var hög smärtintensitet starkt relaterad till rädslundvikande och till föreställningar om samband mellan smärta och funktionshinder hos dem med långvarig RA.

Sammanfattningsvis bidrar detta arbete med kunskap om individers kognitiva värdering av hälsa och hur ett kognitivt synsätt kan användas inom sjukgymnastik.

LIST OF PUBLICATIONS

The present work is based on the following papers, which are referred to in the text by their Roman numerals:

- I. **Lundgren S**, Stenström CH. Muscle relaxation training and quality of life in rheumatoid arthritis. A randomized controlled clinical trial. Scand J Rheumatol 1999;28:47-53

- II. **Lundgren S**, Eurenus E, Olausson Å, Stenström CH. The Swedish version of the Multidimensional Health Locus of Control Scales, form C. Aspects of reliability and validity in patients with rheumatoid arthritis. Manuscript

- III. **Lundgren S**, Eurenus E, Stenström CH and the PARA study group. Health Locus of Control and its relation to physical activity and pain in patients with early rheumatoid arthritis. Submitted

- IV. **Lundgren S**, Olausson Å, Bergström G Stenström CH. Physical activity and pain among patients with rheumatoid arthritis - A cognitive approach. Adv Physiother, in press

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LIST OF ABBREVIATIONS

ACR	American College of Rheumatology
AHI	Arthritis Helplessness Index
AIMS2	Arthritis Impact Measurement Scales 2
ASES	Arthritis Self-Efficacy Scale
CI	Confidence Interval
CBT	Cognitive Behavioral Training
CG	Control Group
CRP	C-Reactive Protein
DAS28	Disease Activity Score
DMARD	Disease-Modifying Anti-Rheumatic Drugs
ESR	Erythrocyte Sedimentation Rate
HADS	Hospital Anxiety and Depression Scales
HAQ	Stanford Health Assessment Questionnaire
HLoC	Health Locus of Control
HQoL	Health-related Quality of Life
IASP	International Association for the Study of Pain
ICC	Intraclass Correlation Coefficients
ICF	International Classification of Functioning, disability and health
IMF	Index of Muscle Function
mFABQ	modified Fear-Avoidance Beliefs Questionnaire
MHLC-C	Multidimensional Health Locus of Control Scales, form C
NHP	Nottingham Health Profile
NSAIDS	Non-Steroidal Anti-Inflammatory Drugs
OR	Odds Ratio
PAIRS	Pain and Impairment Relationship Scale
PARA	Physical Activity in Rheumatoid Arthritis
RA	Rheumatoid Arthritis
RF	Rheumatoid Factor
RTG	Relaxation Training Group
SCT	Social Cognitive Theory
SD	Standard Deviation
SIP-RA	Sickness Impact Profile RA
TENS	Transcutaneous Electrical Nerve Stimulation
TNF-a	Tumor Necrosis Factor alpha
VAS	Visual Analogue Scale
WCPT	World Confederation of Physical Therapy
WHO	World Health Organization

1 INTRODUCTION

Physical therapy aims at preventing, analyzing and treating disturbances in functioning that limit the individual. Treatment may be carried out hands-on by the therapist or as activities recommended or introduced by the therapist. Such activities may target reduction of pain and physical inactivity. A gradual shift towards more active patient involvement in physical therapy treatment has taken place during the past few decades. New demands are thus put on physical therapists as to broadening their theoretical knowledge and being able to introduce and implement behavior change among their patients. In this respect it is also important to understand individuals' cognitive appraisals of health states, which may be altered with major life events such as the onset of a lifelong illness. Patients with rheumatoid arthritis (RA) are frequently referred to physical therapy for treatment of pain and activity limitation. So far little is known about how their cognition, i.e. thoughts, feelings, and beliefs about their health, is related to physical therapy evaluation and what the effects of cognitive treatments given by physical therapists are.

1.1 PHYSICAL THERAPY

Motion and and/or movement are the main concepts of physical therapy (Tyni-Lenné 1998, Carr *et al* 1987, Hislop 1975). The World Confederation of Physical therapy (WCPT) has defined physical therapy as 'concerned with identifying and maximizing movement potential, within the spheres of promotion, prevention, treatment and rehabilitation. Physical therapy involves the interaction between physical therapists, patients or clients, families and caregivers, in a process of assessing movement potential and in establishing agreed upon goals and objectives using knowledge and skills unique to physical therapists' (WCPT 1999).

The roots of physical therapy lie within medical science and has contributed to the development of the profession in a medical direction (Thornquist 1990). Latterly, however, it has become clear that the medical model is insufficient for treating certain disabilities, such as pain and physical inactivity. Thus physical therapy needs to - and has begun - to investigate how cognition's affect different aspects of health.

To provide a unified and standard framework for the description of health and health-related states, the World Health Organization (WHO) has provided the International Classification of Functioning, Disability and Health (ICF) (WHO 2001), which is widely used in physical therapy.

1.2 PAIN

The International Association for the Study of Pain (IASP) has defined pain as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage' (IASP 1994). Pain is a complex phenomenon influenced by biological, psychological and social factors (Keefe & Bonk 1999) (Figure 1).

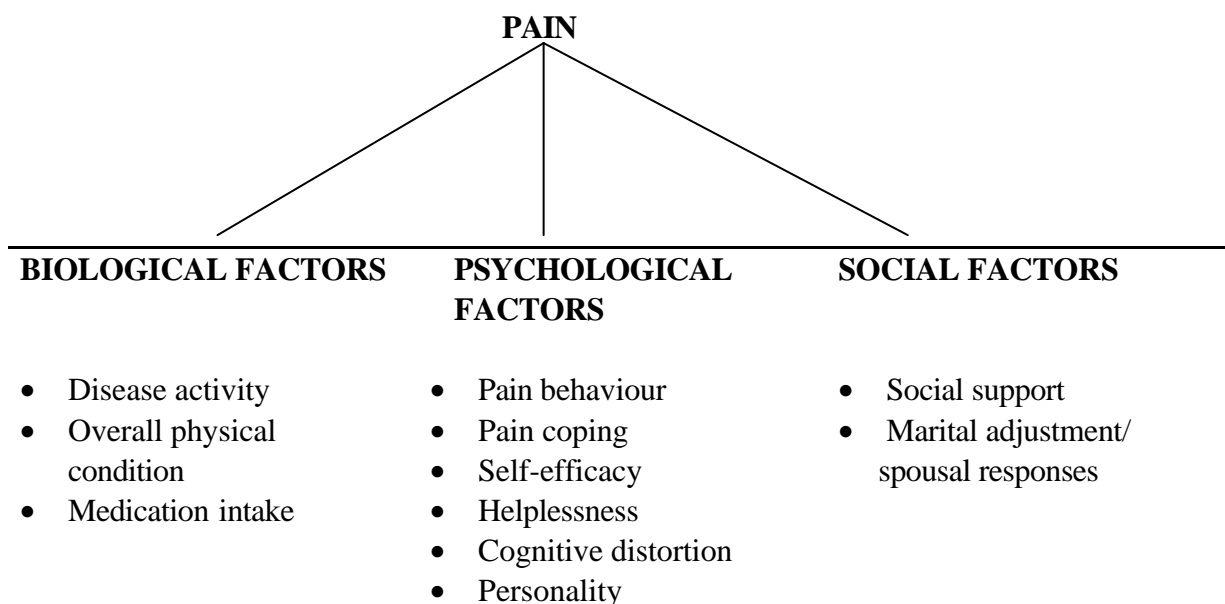


Figure 1. The Biopsychsocial model of pain (Keefe *et al.* 1999).

Pain may be classified as nociceptive, neurological or psychogenic, or as pain of unknown etiology (somatoform pain disorder). *Nociceptive pain* is activated through actual or potential injury to tissues registered by nociceptors, which respond to mechanic, chemical or thermal stimulation. Nociceptors are common in the synovial tissue, joint capsules and ligaments. *Neurogenic pain* is due to injury or dysfunction of the peripheral or central nervous system. *Psychogenic pain* is caused by a mental disorder. *Somatoform pain disorder* is pain without demonstrable or suspected injury or illness (National Board of Health and Welfare 1994).

It has been suggested that pain impairs cognitive functions, in particular as regards attention, such memory, and effort, such as processing information (Brown *et al* 2002, Park *et al* 2001). Cognitive techniques have been widely and successfully used to improve health-related quality of life, but have not resulted in decreased pain (Hammond & Freeman 2004, Barlow *et al* 1999, Bradley & Alberts 1999).

1.3 PHYSICAL ACTIVITY

Physical activity, defined as any kind of bodily movement (Macera *et al* 2001, Caspersen *et al* 1985), includes by definition everyday physical activity as well as planned exercise. Physical inactivity denotes a level of activity less than that needed to maintain good health (NIH 1995). Physical inactivity is a general health problem in the western world (Center of Disease Control 1997, NIH 1995) and a majority of people are not physically active enough to achieve or maintain good health (Macera *et al* 2001). Physical inactivity contributes to health-related problems, such as cardiovascular diseases and early mortality, and epidemiological and experimental studies indicate that physical activity reduces risk factors for coronary heart disease (McKechnie & Moska 2003, Oja 2001, Pate *et al* 1995) and other physical and psychological health problems. It

is thus recommended that every adult accumulate at least 30 minutes of moderate physical activity, most days of the week (Snieszek *et al* 2003).

1.4 SELF-RATED HEALTH

The WHO has defined health as ‘a state of complete physical, mental and social well-being’ (WHO 1988). Several authors have tried to give a concrete form to this definition by dividing it into components such as activity, good interpersonal relations, self-reliance, work, and social situation (Schron & Shumaker 1992, Hornquist 1982). Further, ‘complete well-being’ has been criticized as unattainable and therefore many discard the definition as unrealistic. The WHO has recently modified the definition of health by including ‘a dynamic state’ instead of ‘a state’ of well-being and added ‘spiritual well-being’ to the list of ‘physical, mental and social well-being’ (WHO 2001).

‘Self-rated health’ has been defined as well-being and functioning as perceived by the individual (Vang & Kristenson 2000). Other terms frequently used as more or less synonymous with self-rated health are ‘global health’, ‘general health perception’ and ‘health-related quality of life (HQoL)’ (Vang & Kristenson 2000). HQoL has been defined as ‘the value assigned to duration of life as modified by impairments, functional status, perceptions, and opportunities influenced by disease, injury, treatment, and policy’ (Guyatt *et al* 1993). It encompasses physical, mental (emotional and cognitive), social, and role functioning as well as an individual’s perception of health and well-being (Maciejewski 1997).

Self-rated health seems to be related to the cognitive appraisal of the disease rather than to its severity (Pucheu *et al* 2004). Poor self-rated health is also significantly associated with middle-aged mortality, especially among men (Kopp *et al* 2004).

1.5 A COGNITIVE APPROACH

Suggestions that about 40% of patients seeking health care are feeling ill despite the absence of a specific disease tell us that the ‘reductionist’ medical model is insufficient for dealing with peoples' health (Turk 1996). During the past two decades this realization has received increasing attention, and other approaches, such as cognitive behavioral training (CBT) and cognitive assessment methods, have been introduced. Cognitive interventions in musculoskeletal disorders have resulted in pain relief, healthier behavior, increased quality of life, increased self-efficacy and decreased disability (Ostelo *et al* 2005, Dysvik *et al* 2004, Kelley & Abraham 2004, Wells-Federman *et al* 2003).

1.5.1 Cognitive theories

Cognitive appraisal of a health condition may be categorized as primary or secondary. Primary appraisal focuses the threat that a disease or a disability represents to an individual and secondary appraisal the perceived possibility to handle that threat. Coping is the actual behavior used to minimize the threat (Gonzalez *et al* 1990).

1.5.1.1 *Social learning theory*

Social learning theory was developed by Rotter (1954) and later renamed ‘social cognitive theory’ (SCT) by Bandura (1986). It is a framework for understanding human social behavior and the interaction between individual, environment and health behavior. SCT proposes that a new behavior can be learned by observations of other people, and the behavior does not need to be rewarded directly, as formerly believed in stimulus-response theory. Major concepts of SCT are ‘environment’ (physically external factors that can affect a person’s behavior), ‘outcome expectations’ (the realization that certain events will occur as a response to behavior in a specific situation) and positive or negative ‘reinforcement’, the response to a person’s behavior. Other theories, such as self-efficacy (Bandura 1977) and the concept of health locus of control, are derived from the SCT.

1.5.1.2 *Health locus of control*

Factors determining people’s health-related behavior are focused in the concept of ‘Health locus of control’ (HLoC). HLoC is a function of prior health status and health-related experience, and refers to individual beliefs regarding where control over one’s health lies, internally or externally (Rotter 1967, 1966, 1954). Behavior is here considered as a function of the expectation that a certain action will lead to specific reinforcement for that situation and the value of that situation. The reinforcement may be either positive (reward) or negative (punishment) and is categorized as internal or external. Internal reinforcement is a person’s own experience of the value of a specific event and external reinforcement is when the value of a specific event is predicted based on outcomes of earlier experience. From this, people develop both general and specific expectations, and the belief that certain outcomes regarding health are results of their own actions (internal health locus of control) or a result of other forces independent of themselves (external health locus of control).

People with high internal HLoC believe that they actively influence their health. They see a connection between their actions and their health. They tend to behave more adaptively, to take more active interest in their health care, and to be less depressed (Oberle 1991). People who on the other hand believe that their health status is highly influenced by other peoples’ actions or chance, luck, or faith are said to possess external health locus of control. People with high external HLoC do not believe that their own actions are important for their health and do not see connections between their actions and health. Furthermore, among the chronically ill, high external health locus of control seems to be associated with a higher prevalence of disability (Mackenbach *et al* 2001). However, to describe internals as ‘good guys’ and externals as ‘bad guys’ is not the intention with the locus of control model: there must be a certain limit to personal control; people cannot fully control things like car accidents or diseases (Rotter 1975).

1.5.1.3 *Learned helplessness*

Another theory for explaining how cognitive factors influence health is 'learned helplessness' (Abramson *et al* 1978, Seligman & Maier 1967). Individuals who expect neither negative nor positive outcomes, and at the same time feel a lack of control over these, are said to possess learned helplessness (Smith *et al* 1990).

1.5.1.4 *Fear-avoidance*

The fear-avoidance model refers to the avoidance of movements or activities because of fear of pain and/or (re)injury (Wadell *et al* 1993). The model embraces two approaches; instrumental or 'activity' avoidance and cognitive or 'fear'-avoidance models (Vlaeyen & Linton 2000). When a stimulus begins to predict pain, avoidance learning, which may lead to disability, begins. Escape and avoidance behavior follow from fear; for example daily activities may no longer be performed if they are expected to produce pain. Empirical studies of patients with back pain have confirmed the relationship between high fear-avoidance and estimated pain (Burton *et al* 1999). Fear-avoidance can be modified by interventions such as graded exposure to the feared stimuli and information and training (Wadell *et al* 1993). In patients with long-standing pain, fear-avoidance and beliefs about pain are significant predictors of decreased walking speed (Al-Obaidi *et al* 2003) and also more important determinants of activity limitations than pain itself (Denison *et al* 2004).

1.5.1.5 *Cognitive intervention*

Cognitive-behavioral training (CBT) includes a wide variety of interventions with a common theoretical core of assumptions. The first is that individuals develop expectations about the consequences of a certain event and that these consequences influence behavior. Secondly, cognition interacts with psychological and emotional reactions and with behavior. The third assumption is that the environment may influence behavior, or vice versa (Turk & Rudy 1989). CBT seeks to help patients become active and efficient problem solvers, to help them identify the relationships between environmental events and their own thoughts, emotions and behavior (Turk & Rudy 1989), to help them cope effectively with stressful events, and to maintain the acquired skills (Sacco *et al* 2004, Holzman *et al* 1986).

Cognitive techniques reportedly improve coping abilities, emotional stabilization and HQoL, rather than resulting in actual decrease of pain (Viljanen *et al* 2003, Bradley & Alberts 1999, Barlow *et al* 1999, Leibing *et al* 1999, Sinclair *et al* 1998, Keefe *et al* 1997, Parker *et al* 1995, O'Leary *et al* 1988).

1.5.1.6 *Relaxation training*

Relaxation shifts attention away from pain and illness and improves the ability to rest and sleep. Relaxation training increases awareness of increased tensions, and the most important benefit of such training is reduced muscle tension (Setterlind 1990). Progressive relaxation training, performed as tension and relaxation of major muscle

groups throughout the body, is frequently used and is based on the assumption that muscle tension is related to physiological and cognitive states (Vlaeyen *et al* 1995). It is the most widely used relaxation technique when dealing with chronic pain. The method is based on the physiological research presented by Jacobsen in 1929 and further developed during subsequent years. In his work Jacobsen pinpointed the following three aspects of progression

- Relaxation in one muscle group increases gradually and progressively as the training continues,
- The training goes muscle group by muscle group in turn, step-by-step,
- Regular and purposeful training gradually results in relaxation coming by itself, whereby the feeling of tranquility will be maintained automatically.

Jacobsen considered that relaxation in a skeletal muscle also leads to relaxation in the connected afferent and efferent nerves. Thus patients, by getting rid of unnecessary tension, consume less physical and psychological energy. Regular training is the crucial point in progressive relaxation. Jacobsen considered the time and care spent, together with the person's physical and psychological status, to be determining factors for quality and result. The goal of progressive relaxation is to transfer the ability to relax to situations of every day life (Jacobsen 1938, 1929).

1.5.1.7 Imagery training

The aim of imagery training is to divert attention away from unpleasant symptoms such as pain (Schiaffino 1995). Many types of pleasant imagery are used, the most common being picturing oneself on a sunny beach or that pain is flowing out of one's body. One focuses on the imagined scene for a specific time, together with instructions to involve as many senses as possible (i.e. imagine seeing/hearing something agreeable, smelling or tasting pleasant things).

1.5.2 Assessment of cognition

Several questionnaires have been developed and widely used to capture individuals' thought patterns and to evaluate effects of various types of intervention. Among the most frequently used are the Arthritis Helplessness Index (AHI) (Nicassio *et al* 1985), the Arthritis Self-Efficacy Scale (ASES) (Lorig *et al* 1989), the MHLC-C (Wallston *et al* 1994), the Fear-Avoidance Beliefs Questionnaire (Wadell *et al* 1993) and the Pain and Impairment Relationship Scale (PAIRS) (Riley *et al* 1988). They have all been developed and validated in their original versions for patients with long-standing pain and/or arthritis. Many have also been translated and validated for use in Sweden (Buer & Linton 2002, Lomi 1992, Lomi & Nordholm 1992, Lindroth *et al* 1994), but there is still no valid Swedish version of the MHLC-C.

1.6 MEASUREMENT PROPERTIES

The value and the conclusions of an assessment depend on the validity and the reliability of the assessment method used (Finch *et al* 2002).

Validity is commonly regarded as the degree to which an assessment method actually measures what it is intended to measure (Finch *et al* 2002). The aspects of validity focused in the present work are ‘content validity’, the extent to which a measure represents a balanced and adequate sampling of relevant dimensions, knowledge and skills and ‘construct validity’, the degree to which a measure is measuring what it claims to measure (Mitchell & Joley 1996) without duplicating other measures.

Reliability indicates how far a measure is affected by random error and is often, as in this study, tested by ‘test-retest reliability’ over a certain period of time. The degree to which each item correlates with the overall test score is termed ‘internal consistency’ (Mitchell & Joley 1996).

1.7 RHEUMATOID ARTHRITIS

1.7.1 Clinical manifestations of RA

RA is a chronic autoimmune disorder of unknown etiology. It is progressive and systemic, affects the connective tissue, and is associated with symmetrical polyarticular synovitis. Both intra- and extra-articular manifestations are associated with RA. The inflammatory response in the synovial tissue results in proliferation and pannus, which lead to destruction of cartilage and other joint structures. Initially the synovitis appears mainly in the fingers and the toes but any synovial joint may be affected. The extra-articular manifestations can be anemia, pericarditis, pleuritis, vasculitis and rheumatic noduli. There is also an increased risk of neurological complications with instability from the cervical spine as the most important feature. Amyloidosis most commonly affects the kidneys, the liver, the heart, the lungs and the central nervous system, and is one of the causes of premature death in patients with RA.

Major symptoms of RA are morning stiffness, pain and fatigue, but the disease process often affects functioning and health in a broad sense. Reduced aerobic fitness, decreased muscular strength and endurance, limited flexibility and poor standing balance have been found in studies involving patients with RA (Eurenius *et al* 2005, Häkkinen *et al* 2002, Cimen *et al* 2001, Noren *et al* 2001, Häkkinen *et al* 1995, Ekdahl & Broman 1992, Ekdahl & Andersson 1989, Minor *et al* 1988, Beals *et al* 1985, Nordemar *et al* 1976, Ekblom *et al* 1974). The unpredictable course may also be associated with psychological difficulties, which are found in about 30% of patients (VanDyke *et al* 2004, Minnock *et al* 2003, Dick *et al* 2002). Work disability is frequent, about 30% of patients receiving disability pensions one to three years after disease onset (Puolakka *et al* 2005, Lacaille 2005, Eberhardt 2004). There is also a risk of premature death in RA, mainly from cardiovascular and cerebrovascular diseases (Wolfe *et al* 2003, Kvalvik *et al* 2000).

1.7.2 Prevalence and diagnosis of RA

The prevalence of RA is between 0.5% to 1%, increasing with age. Median age at onset is 55 years and 70% are female (Wollheim 2000).

There is no single test to establish the diagnosis of RA. The clinical history and the physical examination are the most important tools. Physical examination should cover tenderness, swelling, pain on motion, range of motion and deformity. The diagnosis is based on criteria established by the American College of Rheumatology (ACR) (Arnett *et al* 1988). Laboratory tests may be normal, but three types of test are valuable when assessing the activity and severity of RA, and may contribute to the diagnosis. General hematological data aim at detecting anemia. Acute phase reactants, erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP), indicate inflammatory activity and are usually elevated. The rheumatoid factor (RF) is present in 70-80% of patients with RA. It cannot be used alone, but, together with other typical findings, can help to confirm the diagnosis (Pincus *et al* 1996). Radiographic findings may confirm those from physical examination, but as the disease progresses the cartilage destruction can also be seen and assessed with radiography.

1.7.3 Pain in RA

Pain is a major symptom in RA and the main reason for patients to consult health care (Heiberg & Kvien 2002, Bradley & Alberts 1999). Both people with early RA and those with long-standing RA have reported pain levels twice as high as healthy controls and, despite modern medication, it is unusual for these patients to be free of pain (West & Jonsson 2004, Bradley *et al* 1992). Patients with RA regard pain as more important for self-rated health than physical and psychological disability (Ward *et al* 1993).

Nociceptive pain is the most frequent type of pain in RA and may have several converging origins. Synovitis, stress on periarticular structures, muscle tension, and joint destruction are common sources of nociceptive pain (DeAngelo & Gordin 2004). The pain may also be of a neurological origin as a result of cervical spine involvement or swelling of wrists and the posterior parts of the feet (Smith *et al* 2004, Geoghegan *et al* 2004, Singh *et al* 2003). Pain perception is always influenced by psychological, physical and social factors, irrespective of the origin of the pain.

Pharmacological interventions to reduce disease activity are not always effective in eliminating pain: it is in fact unusual for patients with RA to be free of pain (Bradley *et al* 1992).

1.7.4 Physical activity in RA

The guidelines on 30 minutes of moderate physical activity most days of the week developed for the general population have also been adopted for patients with RA (Work group recommendations 2003). RA is reportedly a barrier to physical activity (Seefeldt *et al* 2002) and great efforts are being made to increase physical activity levels

among patients with RA (Work group recommendations 2003). Several authors have reported lower physical activity levels among patients with RA, both early and longstanding, than among the general population (Eurenius & Stenström 2005, Semanik *et al* 2004). Common features of RA, such as pain, joint stiffness and joint damage, produce both activity limitation and psychological consequences (Escalante *et al* 1999). However, the variation in self-reported physical activity has not been explained by factors related to demographics, disease activity, or physical fitness. Thus, cognitive factors may be possible mediators as suggested by Eurenius *et al* (2003). Surveys of cognitive factors and their impact on physical activity among patients with RA are still scarce.

1.7.5 Self-rated health in RA

Self-rated health is an important indicator when assessing the burden of disease, especially in chronic conditions (Mo *et al* 2004). Poor self-rated health has been found among people with chronic illnesses (Stelmach *et al* 2004). Daily pain, stiffness, fatigue, activity limitation, and participation restrictions are common features of RA, factors that may affect self-rated health (Chorus *et al* 2003). Epidemiological studies demonstrate that, compared to other chronic conditions, arthritis has the highest impact on self-rated health in both men and women (Alonso *et al* 2004, Kosinski *et al* 2002).

1.7.6 A cognitive approach in RA

Progressive muscle relaxation training has been recommended as the basis for mental training (Uhnestål 1993) and seems to be easier to adopt for people with no former experience of relaxation than other techniques such as autogenic training. Taped instructions for progressive relaxation training have a long and widespread tradition in physical therapy, including RA, but the effects have been little evaluated among these patients. Intervention may change self-efficacy, and enhancing someone's self-efficacy also reduces arthritis symptoms (Hainsworth & Barlow 2001, Smarr *et al* 1997, Lorig & Holman 1993). Self-efficacy affects many aspects of social change and views a person as an agent in control of his/her own life (Bandura *et al* 2001). Intervention may change self-efficacy and enhancing someones' self-efficacy also reduces arthritis symptoms (Hainsworth & Barlow 2001, Smarr *et al* 1997, Lorig & Holman 1993).

Few published studies investigate relations between the MHLC-C and life-style factors. Several authors report positive outcomes between internal health locus of control and healthier life-styles (Al-Obaidi *et al* 2003, Steptoe & Wardle 2001, Burton *et al* 1999). However, one study did not confirm relations between self-reported physical activity and health locus of control (Jensen *et al* 1991). To our knowledge, no valid and reliable Swedish version of the MHLC-C exists.

Patients with RA often develop a sense of helplessness when dealing with daily life. Longitudinal studies have found baseline helplessness to be related to depressed mood, psychological and physiological disability. It also predicts flare-ups in the disease (Schoenfeld-Smith *et al* 1996). Learned helplessness correlates with high external and low internal control (Wallston *et al* 1994). Patients scoring high on the AHI possess lower

internal health locus of control and higher anxiety, depression and impairment in performing activities of daily living (Nicassio *et al* 1985).

Fear of movement because of pain, and beliefs about pain, have been suggested as potential barriers to physical activity (Minor 1996, Jensen *et al* 1994), but so far little is known about fear-avoidance beliefs and pain beliefs in RA.

In meta-analyses of the effects of imagery techniques to decrease pain in patients with RA, osteoarthritis and fibromyalgia, only smaller effect sizes have been found. However, most of the studies need to improve quality (Astin *et al* 2002, Hadhazy *et al* 2000, Superio-Cabuslay *et al* 1996).

1.7.7 Treatment of RA

Since there is no definite cure for RA, treatment aims to reduce symptoms of illness and disability in order to achieve the best possible outcome. Treatment in RA is based on the assumption that drug therapy and non-drug therapy should act together. Five types of drugs are important in patient management. Analgesics are used to reduce pain. Non-steroidal anti-inflammatory drugs (NSAIDS), previously often used as the first choice, have during the past ten years rather been used as complements to disease-modifying anti-rheumatic drugs (DMARD), which are nowadays introduced earlier in the disease course. Tumor necrosis factor alpha (TNF- α) blockers, introduced in recent years, represent a major breakthrough in the treatment of RA (Sivakumar & Paleolog 2005). However, about 25 % of patients do not respond to this drug and its long-term effects are not yet known. Corticosteroids have a long history in the treatment of RA and may be administered orally or parenterally, most frequently as intra-articular injections. Surgical treatment may be needed in the locomotor system to restore skeleton, muscles or nerves. Conservative treatment, including physical therapy, occupational therapy and social counseling, focus on reducing impairments, activity limitations and participation restrictions caused by RA. Patients are encouraged to be active parts of their rehabilitation. Thus an important element is patient education to increase knowledge, self-esteem and self-efficacy (Lorig & Holman 1993).

1.7.8 Physical therapy in RA

The physical therapy treatment in RA traditionally consists of techniques for sensory stimulation, such as superficial heat and cold, transcutaneous electrical nerve stimulation (TENS), acupuncture, and massage; all aiming at reducing the symptoms, mainly pain. Aerobic exercise on land or in water is commonly used together with specific exercises to preserve range of motion, muscle strength and endurance, and balance/co-ordination. The benefits of dynamic exercises for patients with RA have been documented in several studies (Stenström & Minor 2003, van den Ende *et al* 1998, Stenström 1994, Nordemar *et al* 1981, Ekblom *et al* 1974). However, interventions with physical modalities or exercise may not be enough for successful treatment.

Several authors have investigated the effects of cognitive-behavioral training and relaxation training, demonstrating significant reductions in pain, pain behavior, disease

activity, depression and joint tenderness (Bradley & Alberts 1999, Keefe & van Horn 1993, Parker *et al* 1993, Bradley *et al* 1987). Pain coping for the adjustment to arthritis has been found valuable by several authors, exemplified by decreases in pain and increases of positive mood (Affleck *et al* 1999, Keefe *et al* 1997, Keefe *et al* 1992). Relaxation training is often recommended by the physical therapist to patients with RA, but is still poorly evaluated, as is the use of taped instructions.

More research is needed in this area in order to make physical therapists aware of the patients' cognitive appraisal of their functioning, disability, and health in order to meet patients on their individual level.

2 AIMS

The overall aim of the present work was to investigate pain and physical activity in patients with RA from a physical therapy perspective and a cognitive approach.

Specific aims were

- I to investigate the influence on quality of life, pain intensity, muscle function and disease activity of a muscle relaxation training program consisting of 10 weeks' supervised group exercises,
- II to evaluate some measurement properties of a Swedish MHLC-C,
- III to describe health locus of control and its relations with physical activity, pain intensity, and general health perception. A further aim was to analyze relations between health locus of control and age for men and women separately, and
- IV to describe relationships between *physical activity* and beliefs about pain, beliefs about fear-avoidance and health locus of control; and to describe relations between *pain intensity* and the same three variables.

3 METHODS

3.1 PATIENTS

The patients in this thesis were recruited from the Rheumatology Unit at the Rehab Centre, Vänersborg (Studies I, II), the Department of Rheumatology at Karolinska Hospital, Stockholm (Study II), the Department of Rheumatology, Kärnsjukhuset, Skövde (Studies II and IV) and from the Swedish multicenter study Physical Activity in Rheumatoid Arthritis (PARA) (Studies II and III). Patients were all diagnosed with RA according to the revised ACR criteria (Arnett *et al* 1988). Study II included participants from three sub-samples.

A total of 585 patients participated in the four studies. A majority of the patients were ambulant, with or without aid devices for walking or for activities of daily living. Demographic data and the cumulative number of patients are presented in Table I.

Table I. Demographic data of all patients included in this thesis.

Paper	Patients included n	Patients accumulative n	Male/ Female	Age, years m (SD)	Disease duration, years m (SD)
I					
Pilot study	20	20	4/16	56 (10.8)	9.8 (10.1)
Main study	68	88	16/52	57 (11.2)	12 (9.3)
II					
Total	426	514	115/311	57 (14.6)	-
Sub-sample					
I	108		32/76	54 (14.9)	7 (9.1)
II	95		24/71	60 (11.2)	13 (11.6)
III	223		59/164	57 (15.3)	≤ 6
III	294	585	73/221	56 (15.3)	≤ 6.5
IV	95	585	24/71	60 (11.2)	13 (11.6)

3.2 ASSESSMENTS

An overview of the assessment methods used in the present thesis is given in Table II. The measurement properties of all rating scales, questionnaires, physical capacity tests, and manual and laboratory tests used in the thesis have been investigated in individuals with arthritis and/or long-standing pain.

Table II. Assessments used in studies I-IV, classified within the components of the ICF.

Assessments	Study	Body structure and body function	Activity and Participation	Personal factors	Environmental factors
Arthritis Impact Measurement Scales 2 (Meenan et al 1992, Archenholtz & Bjelle 1997)	I	X	X		X
Nottingham Health Profile (Hunt & Wiklund 1987)	I	X	X		X
Sickness Impact Profile-RA (Bergner et al 1981, Sullivan et al 1993)	I		X	X	X
Arthritis Self-efficacy Scale (Lorig et al 1989, Lomi 1992, Lomi & Nordholm 1992)	I			X	
Index of Muscle Function (Ek Dahl et al 1999)	I	X	X		
Visual Analogue Scale, pain intensity (Huskisson 1982)	I-IV	X			
Erythrocyte sedimentation rate (Scott et al 1993)	I				
Doctor's global assessment (Scott et al 1993)	II, III	X			
Multidimensional Health Locus of Control Scales, form C, first draft (Wallston et al 1994)	II, III,			X	
Multidimensional Health Locus of Control Scales, form C, revised (Wallston et al 1994)	II, III, IV			X	
Stanford Health Assessment Questionnaire, functional disability index (Fries et al 1980)	II, III, IV		X		

Hospital Anxiety and Depression Scales <i>(Zigmond & Snaith 1983)</i>	II, IV		X		X	
Arthritis Helplessness Index, 15-item <i>(Nicassio et al 1985, Lindroth et al 1994)</i>	II		X		X	
Arthritis Helplessness Index, 10-item <i>(Nicassio et al 1985, Lindroth et al 1994)</i>	II		X		X	
Physical Activity Index <i>(Engström et al 1993)</i>	III, IV		X			
Visual Analogue Scale, patients' global health <i>(Scott et al 1993)</i>	III	X	X		X	X
C-reactive protein <i>(Scott et al 1993)</i>	III	X				
Disease Activity Score 28 <i>(Scott et al 199)</i>	III					
Pain and Impairment Relationship Scale <i>(Riley et al 1988, Linton & Buer 1995)</i>	IV				X	
modified Fear–Avoidance Beliefs Questionnaire, (0-28) <i>(Buer & Linton 2002)</i>	IV	X			X	

Descriptive data regarding gender, age, sickness duration, arthritis-related drugs, including steroid injections, were collected in specific questionnaires.

The Multidimensional Health Locus of Control Scales, form C was developed from a general locus-of-control measure presented by Levenson (1973), and further developed into the MHLC, forms A and B (Wallston *et al* 1978). In 1994 the MHLC-C, which can easily be adapted to all medical or health-related conditions, was presented (Wallston *et al* 1994). The MHLC scales have since been frequently used as measures of health-related beliefs in other settings than patients with RA (Clarke & Gross 2004, Hashimoto & Fukuhara 2004, Steptoe & Wardle 2001). The MHLC-C is self-administered and includes 18 items, all including the word 'condition' which can be replaced with any specific medical problem/condition, in the present study 'arthritis'. The items are divided into four sub-scales; 'Internal', 'Chance', 'Doctors' and 'Other people' including six, six, three, and three items respectively, followed by 6-point Likert scales. Sum-scores are calculated for each sub-scale; a high score indicates a strong belief in internal, chance, doctors' or other people's control (Wallston *et al* 1994). The original MHLC-C was translated to Swedish and then back to English. The two English versions were compared and discussed by an expert group of health professionals and professional translators as to content, and minor revisions of a first draft of the Swedish MHLC-C were carried out. Two versions of the Swedish MHLC-C have been used in the present thesis; one first draft and one revised. When interpreting sum-scores of the sub-scales please note that the possible range for the sub-scales 'Doctors' and 'Other people' is only half of the other sub-scales (Wallston *et al* 1994).

3.3 RELAXATION TRAINING

The patients of Study I were randomized to either a relaxation training group (RTG) or a control group (CG). Both groups were assessed before and after the ten-week intervention period and at follow-up after 6 and 12 months. At the 12-month follow-up they were also asked to rate their supplementary home exercise, during the 10-week training period and follow-up. Both groups followed their regular medical check-ups, treatments and physical therapy programs.

A ten-week training period was set up with progressive muscle relaxation training ad modum Jacobsen (1938) and imagery techniques (Uhnestål 1993). The training sessions lasted 30 minutes twice a week, used taped instructions and were supervised by an independent physiotherapist. The patients received the tapes and were encouraged to use them at home both during the training period and during follow-up.

3.4 STATISTICS

An overview of the statistical methods used in this thesis is given in Table III. The minimum significance level was set to $p < 0.05$ in all studies included. Two-tailed tests, with α set to 0.05 and β to 0.2, were used to investigate statistical power for Study I.

Correlation coefficients were interpreted; $r = 0-0.25$ as 'little if any correlation', $r = 0.26-0.49$ as 'low', $r = 0.50-0.69$ as 'moderate', $r = 0.70-0.89$ as 'high', and $r = 0.90-1.0$ as 'very

high' (Altman 1995). Intraclass correlation coefficients were considered to indicate good reliability above 0.75 and moderate-to-poor reliability if 0.75 or below (Fleiss 1986). Cronbach's coefficient alphas above 0.70 were judged as good (Hatcher 1994).

The 'Logistic Regression for ordinal responses (proportional odds model)' was used in studies III and IV when the response variable, i.e. pain, had more than two categories. Medians and interquartile ranges were used in studies III and IV to subdivide scales into four categories. Medians and interquartile ranges were used in Studies III and IV to subdivide independent variables into four categories.

Table III. Survey of statistical methods used in this thesis.

	I	II	III	IV
Descriptive statistics				
Mean, SD		x		x
Median, range	x	x	x	x
Percent (%)	x		x	x
Confidence interval			x	x
Analytical statistics				
Mann-Whitney U-test	x		x	
The maximum likelihood factors with Rotation varimax normalized		x		
Pearson correlation coefficient		x		
Intraclass Correlation Coefficients (ICC), model 3.1.		x		
Cronbach's coefficient alpha		x		
Distance weighted least squares			x	
Spearman rank order correlations			x	
Logistic regression for multivariate Purposes			x	x
Logistic Regression for ordinal responses (proportional odds model)			x	x

3.5 ETHICS

All the studies included in this investigation were approved by the Research ethics committees at the Sahlgrenska Hospital in Göteborg (Study I), the University of Göteborg (Studies II and IV), and the Karolinska Institutet (Study III).

4 RESULTS

4.1 STUDY I

An initial pilot test indicated that some sub-scales of the AIMS2 required the fewest patients for conclusive results, while the SIP-RA was the assessment method requiring the fewest patients for conclusive results on a total score. The ASES and the NHP both required more patients for conclusive results.

The results are based on the 33 participants from the RTG and the 27 from the CG who completed the study. The results indicated statistically significant improvements in the RTG compared to the CG regarding self-care according to the AIMS2 ($p < 0.05$), and in recreation and pastimes according to the SIP-RA ($p < 0.05$) directly after the intervention. Mobility and arm function ($p < 0.01$) according to the AIMS2 and muscle function of the lower limbs ($p < 0.05$) were improved after six months. No significant differences in pain intensity were found and no significant improvements remained after twelve months. The intake of medication was unchanged during the 10-week intervention period for 23 (70%) and 17 (61%) of the participants in the RTG and the CG respectively.

4.2 STUDY II

The descriptive results showed that the patients attributed their health locus of control mainly to doctors and secondly to chance, themselves or to other people. There were no differences between men and women in this respect.

4.2.1 Content validity

The first factor analysis based on data from the 108 patients in sub-sample I confirmed similarities between the groupings of the first-draft Swedish MHLC-C items and the original version. Seventeen of 18 items loaded on their expected factors, while one item did not. A second factor analysis of a revised Swedish MHLC-C, with the failing item reworded and based on data from 318 individuals in sub-samples II and III, was run. Again, four factors emerged and the reworded item now loaded on the expected sub-scale (Table IV).

4.2.2 Construct validity

Correlations between the Swedish MHLC-C sub-scales and between them and background factors disease activity, emotions, and attitudes were mainly little if any ($r_p = 0-0.25$). However, low correlations were found between the MHLC-C sub-scale 'Other people' and the sub-scales 'Chance' ($r_p = 0.29$, $p < 0.001$) and 'Doctors' ($r_p = 0.33$, $p < 0.001$) respectively. A low negative correlation between 'Doctors' and depression ($r_p = -0.29$, $p < 0.001$) was found. Low correlations were also found between the three external MHLC-C sub-scales and learned helplessness ($r_p = 0.29-0.33$, $p < 0.01$).

Table IV. Results of the factor analysis of the revised Swedish MHLC-C, with item two reworded, for 316 patients included in sub-samples II and III. The highest factor loading for each item is in bold text. The loadings on the left side of the slash indicate the results from the present study, while those to the right emerged in the factor analysis of the original American MHLC-C.

		Internal	Chance	Doctor	Other people
1	If my arthritis worsens, it is my own behaviour which determines how soon I feel better again	.68/.70	-.04/-.01	-.01/.08	-.01/.19
2	It may go anyhow with my arthritis, neither I or anybody else can influence it.	.07/-.19	.34/.63	.00/-.06	.06/-.04
3	If I see my doctor regularly, I am less likely to have problems with my arthritis	.16/.13	.03/.00	.64/.77	.09/.10
4	Most things that affect my arthritis happen to me by chance	.00/.03	.43/.61	-.03/.12	.21/.05
5	Whenever my arthritis worsens, I should consult a medically trained professional	.03/.01	-.04/.09	.71/.80	.05/.07
6	I am directly responsible for my arthritis getting better or worse	.69/.81	-.04/-.11	.10/.02	.05/.03
7	Other people play a big role in whether my arthritis improves, stays the same, or gets worse	.06/.16	.02/.11	.05/.05	.79/.72
8	Whatever goes wrong with my arthritis is my own fault	.66/.81	.13/-.08	-.07/.01	.05/.06
9	Whatever improvement occurs with my arthritis is largely a matter of good fortune	.05/-.04	.74/.66	-.17/-.14	.16/.23
10	In order for my arthritis to improve, it is up to other people to see that the right things happen	-.18/-.18	.21/.23	.18/.06	.72/.72
11	Luck plays a big part in determining how my arthritis improves	-.02/-.04	.80/.66	-.02/-.14	.11/.23
12	The main thing which affects my arthritis is what I myself do	.71/.68	-.11/.14	.09/.11	-.01/-.04
13	I deserve the credit when my arthritis improves and the blame when it gets worse	.69/.79	.21/.01	.06/.01	-.04/-.04
14	Following doctor's orders to the letter is the best way to keep my arthritis from getting worse	.01/.17	.05/-.12	.73/.77	.17/.12
15	If my arthritis worsens, it's a matter of fate	-.02/-.08	.76/.78	.14/.08	-.05/.12
16	If I am lucky, my arthritis will get better	.01/-.04	.73/.71	.20/.00	-.19/-.01
17	If my arthritis takes a turn for the worse, it is because I have not been taking proper care of myself	.62/.65	.04/-.07	.15/.18	.00/.02
18	The type of help I receive from other people determines how soon my arthritis improves	.23/.16	.14/.04	.38/.15	.55/.80
	Eigenvalues	3.242	2.686	1.917	1.142
	Explained variance	2.847	2.742	1.773	1.625

4.2.3 Reliability

The results of the test-retest investigation of the first-draft Swedish MHLC-C in sub-sample I indicated moderate-to-high stability (ICC=0.78-0.63) of the sub-scales. Good homogeneity was demonstrated for the sub-scales 'Internal' ($\alpha=0.81$), 'Chance' ($\alpha=0.82$) and 'Doctors' ($\alpha=0.71$), while it was somewhat lower for 'Other people' ($\alpha=0.61$). Good internal consistency was demonstrated within 'Internal', with Cronbach's alpha from 0.77 to 0.74. For 'Chance', internal consistency was moderate-to-high ($\alpha=0.79-0.65$). Within 'Doctors' and 'Other people' it was moderate ($\alpha=0.63-0.60$ and $0.69-0.51$ respectively).

4.3 STUDY III

The patients with early RA attributed their health locus of control mainly to the doctors, while the other loci were chosen to a much lower, and similar, extent. Gender differences were found in MHLC-C 'Doctors' and 'Other people', which were statistically significantly higher among the men. The median self-reported physical activity behavior indicated that about half of the patient group reached recommended levels for maintaining good health. Pain was higher among the women, as was the perceived effect of disease on general health.

Table V. Odds ratios (OR) for high physical activity, high-intensity pain and poor general health perception, subdivided with MHLC-C Internal, Chance, Doctors, and Other people as independent variables for the 294 study participants.

		Physical activity	<i>p</i>	Pain	<i>p</i>	General health perception	<i>p</i>
		OR (95% CI)		OR (95% CI)		OR (95% CI)	
Internal	Low ^a	1		1		1	
	Q2 ^b	0.80 (0.65-2.42)	0.50	1.28 (0.43-1.40)	0.40	1.04(0.54-1.70)	>0.5
	Q3 ^c	1.89 (0.28-1.03)	0.06	1.89 (0.29-0.97)	0.04	1.33 (0.42-1.31)	0.31
	Hi ^d	0.57 (0.84-3.62)	>0.5	1.96 (0.27-0.98)	0.04	1.61 (0.34-1.14)	0.12
Chance	Low	1		1		1	
	Q2	0.73 (0.63-2.96)	>0.5	1.10 (0.46-1.79)	>0.5	0.80 (0.66-2.37)	0.49
	Q3	1.64 (0.30-1.23)	>0.5	1.08 (0.47-1.76)	>0.5	0.68 (0.81-2.72)	0.21
	Hi	1.52 (0.33-1.31)	>0.5	0.89 (0.59-2.10)	>0.5	0.56 (0.98-3.26)	0.06
Doctors	Low	1		1		1	
	Q2	1.54 (0.35-1.22)	0.18	1.43 (0.40-1.24)	0.22	1.23 (0.47-1.40)	0.45
	Q3	1.54 (0.34-1.26)	0.20	1.89 (0.29-0.97)	0.04	1.79 (0.32-0.99)	0.05
	Hi	1.96 (0.26-0.98)	0.05	2.13 (0.25-0.85)	0.01	1.43 (0.40-1.25)	0.23
Other people	Low	1		1		1	
	Q2	0.46 (0.98-4.78)	0.06	1.22 (0.41-1.63)	>0.5	1.16 (0.46-1.64)	>0.5
	Q3	1.59 (0.33-1.19)	0.15	0.68 (0.84-2.62)	0.18	0.83 (0.69-2.08)	>0.5
	Hi	1.59 (0.34-1.16)	0.14	0.84 (0.68-2.08)	>0.5	0.76 (0.78-2.24)	0.30

^a=1st quartile, ^b=2nd quartile, ^c=3rd quartile, ^d=4th quartile of the MHLC-C sub-scales.

Relations between the MHLC-C subscales and high physical activity, high-intensity pain and poor general health perception are shown in Table V. The patients who attributed their health locus of control highly to doctors were twice as likely to be physically active at a moderate/high level as those with low attribution of control to doctors. High-intensity pain was almost twice as likely among those who attributed their health locus of control highly to either themselves or to doctors. No relations between general health perception and the MHLC-C sub-scales were found.

The scatter plots indicated only weak relations between the MHLC-C sub-scales and age when considering gender. This was confirmed in subsequent correlation analyses, which revealed significant positive correlations only between MHLC-C 'Doctors' and age for the men (R_s 0.41, $p < 0.001$) and for the women (R_s 0.24, $p < 0.001$). No other statistically significant correlations were found between MHLC-C sub-scales and age and gender.

4.4 STUDY IV

Low levels of physical activity and moderate pain levels were found among these patients with mainly long-standing RA. The beliefs in a relationship between pain and impairment was relatively strong, fear-avoidance of physical activity was moderate, and health locus of control was mainly attributed to 'Doctors', secondly internally, to chance or significant others.

Self-reported physical activity was not significantly related to the outcome of PAIRS, mFABQ, or MHLC-C (Table VI). Patients scoring on the highest PAIRS quartile were seven times more likely to experience high-intensity pain than were those scoring on the lowest PAIRS quartile (OR=7.09). Patients scoring on the highest mFABQ quartile were three times more likely to experience high-intensity pain than those in the lowest PAIRS quartile (OR=3.26). None of the MHLC-C subscales demonstrated any significant relation to pain (Table VI).

Table VI. Results of logistic regression models with self-reported physical activity and pain as dependent variables and pain beliefs and attitudes, fear-avoidance, and health locus of control as independent variables (quartile levels) for the 95 patients participating in the study.

	Quartile level	PAIRS		mFABQ		MHLC-C Internal		MHLC-C Chance		MHLC-C Doctor		MHLC-C OP	
		Odds ratio (CI)	<i>p</i>	Odds ratio (CI)	<i>p</i>	Odds ratio (CI)	<i>p</i>	Odds ratio (CI)	<i>p</i>	Odds ratio (CI)	<i>p</i>	Odds ratio (CI)	<i>P</i>
Physical activity	Low	1		1		1		1		1		1	
	Q2	1.63 (0.48-5.47)	0.43	0.76 (0.23-2.55)	>0.50	0.68 (0.20-2.30)	>0.50	0.98 (0.30-3.22)	>0.50	1.53 (0.41-5.64)	>0.50	0.98 (0.30-3.32)	>0.50
	Q3	0.50 (0.14-1.81)	0.29	0.85 (0.26-2.78)	>0.50	0.60 (0.19-1.91)	0.38	1.63 (0.47-5.63)	0.44	1.64 (0.50-5.31)	0.41	1.32 (0.41-4.31)	>0.50
	High	1.62 (0.18-2.07)	0.43	0.39 (0.11-1.37)	0.14	0.73 (0.20-2.72)	>0.50	1.17 (0.35-3.97)	>0.50	0.87 (0.28-2.75)	>0.50	0.59 (0.17-2.10)	0.42
Pain	Low	1		1		1		1		1		1	
	Q2	3.05 (0.98-9.48)	0.05	1.24 (0.44-3.52)	>0.50	0.98 (0.35-2.77)	>0.50	1.30 (0.45-3.73)	>0.50	1.04 (0.36-3.00)	>0.50	0.55 (0.19-1.61)	0.28
	Q3	2.97 (0.95-9.23)	0.06	0.72 (0.25-2.11)	>0.50	0.70 (0.25-1.90)	0.44	0.92 (0.31-2.74)	>0.50	1.12 (0.39-3.22)	>0.50	0.78 (0.28-2.12)	>0.50
	High	7.09 (2.22-22.67)	<0.01	3.26 (1.09-9.79)	0.03	0.51 (0.51-1.70)	0.27	1.50 (0.52-4.37)	0.45	1.04 (0.38-2.90)	>0.50	0.56 (0.18-1.76)	0.32

PAIRS=Pain and Impairment Relationship Scale, mFABQ=modified Fear-avoidance Beliefs Questionnaire, MHLC-C=Multidimensional Health Locus of Control Scales, Form C, MHLC-C OP= MHLC-C Other People

5 DISCUSSION

The main focus of the present work was to investigate pain, physical activity and self-rated health in patients with RA from a physical therapy perspective and a cognitive approach. Some positive outcomes of progressive relaxation training were found, and satisfactory measurement properties of the Swedish MHLC-C were established. The present work also included the first studies describing, among patients with RA, relations between pain and physical activity on one hand and health locus of control, fear avoidance and beliefs about relationships between pain and impairment on the other. It is hoped that the present work will contribute to a better understanding of individuals' cognitive appraisals of health states and what the effects of cognitive treatments as complements to physical therapy may be.

5.1 RELAXATION TRAINING

Regarding improvements in self-rated health and muscle function following relaxation training, the results accord with previous studies (Stenström *et al* 1996, Stenström *et al* 1997), although different aspects were improved. The improvements of muscle function without decreases in pain intensity or disease activity might partly be explained by an increased ability to relax antagonist muscles, which in turn confers better conditions for the agonists' work. A tense muscle hinders range of motion and thus, when the patients felt more relaxed they were able to increase 'self-care' and 'recreation' immediately after the intervention. This in turn may have increased the general physical activity level and may explain the improvement in self-rated health and activity performance at the six-month follow-up. At a cognitive level, the health-related experience from the relaxation training program may have led to positive expectations of reinforcements in these specific situations. However, such aspects were not evaluated in the present work.

Previous literature reveals conflicting outcomes of relaxation training regarding pain intensity. Some studies report findings similar to ours, i.e. relaxation had no effect on pain intensity (Viljanen *et al* 2003, Horton-Ausknecht *et al* 2000). Other studies demonstrate reductions in pain intensity and improved pain-behavior (Affleck *et al* 1990, Parker *et al* 1988, Bradley *et al* 1987). A recent meta-analysis concluded that pain was reduced directly after intervention, but not at follow-up (Astin *et al* 2002). One explanation of the differing results may be different pain origin in patients with RA. Relaxation training programs, such as that used in the present work, are probably most effective if the pain originates from muscles, compared to pain originating from synovitis or joint destruction.

5.2 THE MHLC-C

Translation of questionnaires is a delicate matter. An unintended change in the meaning of one item in the translation process crept in. After discussions in the expert group, the item was reworded in order to relate more explicitly to chance. Consequent analyses confirmed that the reworded item performed well, and was thus included in the proposed version of the Swedish MHLC-C (Appendix).

The construct validity of the Swedish MHLC-C was supported by little, if any, inter-correlations between the internal and external sub-scales, which are intended to measure separate dimensions of health locus of control. The low correlations found between 'Other people' and 'Doctors' and 'Chance', respectively, are probably due to their original inclusion in the same external subscale of MHLC-A (Wallston *et al* 1978). Our finding of little, if any, correlations between the MHLC-C and most other constructs supports health locus of control as a unique construct that does not correlate with demographic or disease-related factors. The low correlations found between external health loci of control and learned helplessness were expected as these constructs may, to some extent, target similar beliefs.

The test-retest stability of the proposed Swedish MHLC-C was satisfactory, and generally better than that demonstrated for the original MHLC-C (Wallston *et al* 1994). The homogeneity of the items within each sub-scale was good for all but 'Other people', where it was somewhat low.

Non-parametric statistical procedures are often recommended for analysis of ordinal data. However, the measurement properties of the original MHLC-C were analyzed with parametric statistics. Thus, parallel analyses were carried out in the present work to analyze the measurement properties of the Swedish MHLC-C. As the analyses did not reveal any major differences, the outcome of the parametric analyses is presented in order to improve comparisons with the data from the original publication on MHLC-C (Wallston *et al* 1994).

5.3 HEALTH LOCUS OF CONTROL

The patient's attribution of health locus of control mainly to 'Doctors' (Studies II-IV), or rather health professionals, seems adequate for patients diagnosed with a life-long illness requiring constant monitoring and treatment in health care. This attribution also accords with a previous study of samples of patients in the USA with long-standing RA and other long-standing illnesses (Wallston *et al* 1994).

The finding of only weak correlations between higher age and the MHLC-C 'Doctors' (Study III) was somewhat unexpected as others have found stronger correlations between higher age and all the MHLC-C subscales (Hashimoto & Fukuhara 2004, Kuwahara *et al* 2004). However, those studies were not conducted in patients with RA. Thus, the present findings may indicate that factors related to the disease itself are more powerful than age and gender as to relation with health locus of control.

Individuals have often been expected to possess either internal or external health locus of control beliefs. This was, however, not the intention with the construct (Rotter 1990). Rather, one individual may possess high or low beliefs in both internal and external control over their health, which may be particularly applicable to those with long-standing illnesses that require regular treatment and monitoring in health care. In a study of 159 Chinese women, 25 were pure 'internals', 36 pure 'externals', 37 'duals', and 61 'no-control believers' (Wu *et al* 2004). In the present work (Study IV) only one patient was purely 'internal' and one purely 'external', while 93 were either high or low on all the MHLC-C sub-scales (data not shown). This might be one reason for the

scarce use of the MHLC-C within health care. Only a few older studies on health locus of control in patients with RA have been published, which might indicate that this construct has not been considered applicable in this context.

5.3.1 Pain and health locus of control

A relation between high internal health locus of control and high intensity pain in patients with early RA was found in the present work (Study III), while no relations between MHLC-C subscales and pain were found among those with long-standing RA (Study IV). One reason might be that patients with early RA stay more active and therefore tolerate higher pain because the positive reinforcements of physical activity rule out the potentially negative reinforcement of pain. This hypothesis is in line with the health locus of control construct (Rotter 1975).

5.3.2 Physical activity and health locus of control

As a relation was found between moderate/high physical activity and high attribution of health locus of control to health professionals among patients with early RA, it was unexpected that no such relation existed among patients with longstanding RA. Thus, the result indicates that such relations may depend on disease duration. A possible explanation for this might be the trust that recently-diagnosed patients may have in the specially-trained health professionals at rheumatology clinics and their recommendations to be physically active. Another explanation might be that patients with shorter disease duration have less disability, which makes it easier to follow such recommendations.

Others have found poorer health behavior among individuals with high external health locus of control (Smith & Mason 2001, Conant 1998, May *et al* 1998), while better health behavior has been found among those with high internal control (Unger 1997). However, none of these studies addressed patients with RA. One reason for the absence of relations between physical activity and internal health locus of control in the present work might be that, particularly among those with early RA, in their new roles as people with disease, they lack the confidence to decide whether physical activity is beneficial for their arthritis. This presumption also fits with the finding of a strong relation between adequate physical activity and high attribution of health locus of control to health professionals.

5.3.3 PAIRS and fear avoidance beliefs

The strong relation between high-intensity pain and strong beliefs in a relationship between pain and impairment found in the present work (Study IV) may not seem surprising. It rather seems natural that those with much pain hold such beliefs, as they may experience constant consequences of their pain in daily life. However, another explanation might be that individuals holding such beliefs are more likely to develop or experience more pain. This needs to be investigated in future prospective studies.

The strong relation between high pain intensity and strong fear-avoidance beliefs (Study IV) is in accordance with previous studies investigating fear-avoidance beliefs as predictors of chronic low-back pain in patients with lumbar and cervical spine pain (Picavet *et al* 2002, George *et al* 2001).

5.3.4 Limitations of the present work

More emphasis on strategies to maintain new skills and use them in daily life might have improved the results of the relaxation training program. The inclusion of patients with more disability, preferably related to muscle pain, might also have been adequate as many of the present patients had very little disability and thus not much room for improvement following the training program. Further, personal instructions during the training sessions and some kind of encouragement during the follow-up period would have improved results. Finally, the fact that the study was not conclusive and that mood and tension were not assessed means that the relaxation training program might have conferred further improvements than those demonstrated.

The choice to investigate test-retest stability of the MHLC-C with two sets of data, one obtained in the waiting room and one at home, might have influenced the results. However, as health beliefs could be expected to show some trait-like stability (Wallston *et al* 1994), this might have been a minor problem. Opinions about the size of correlation coefficients indicating meaningful relationships seem to differ between traditions in medical and behavioral-science literature. In Study II, a more behaviorally oriented way of interpretation was chosen, which may of course be questioned.

As to the external validity of the present work, the participating patients were recruited somewhat differently for the different studies. While there is no reason to suspect systematic bias in the selection of the participating clinics or patients, all samples may be considered as such of convenience. Hence, those who accepted to participate may have had more positive health beliefs and a greater interest in their health than non-participants had. While such problems cannot be avoided as long as study participation is optional, it is still important to bear in mind that the results of the present work can only be generalized to those patients with RA who have similar characteristics.

5.3.5 Clinical implications

Muscle relaxation training with taped instructions improves some aspects of muscle function and self-rated health. However, results might be better with supervised training and the application of strategies for implementing the acquired skills in daily life.

The MHLC-C might be useful in physical therapy for surveying health cognitions among patients with early RA in order to improve strategies for pain reduction and healthy exercise behavior. The PAIRS and the mFABQ might be useful in physical therapy to survey health cognitions among patients with RA in order to improve strategies for pain reduction and healthy exercise behaviors.

5.3.6 Future research

Future studies of relaxation training programs should include evaluation of sleep and contain elements of coaching and follow-up sessions in order to motivate patients to implement the acquired skills in daily life. Another issue of interest to investigate is whether introduction of relaxation training at an early stage of RA would prevent or limit the storage of memories of pain deep in the thalamus, and thus minimize the risk of vicious circles of pain.

Further investigation of the responsiveness and sensitivity to change of the MHLC-C is needed. Beliefs about relationships between pain and impairment and beliefs about fear-avoidance of activity need further investigation in order to develop clinical strategies for reducing such beliefs in patients with RA. Education and graded exposure to movement have been suggested as one way forward in work with patients with long-standing pain who report high fear-avoidance beliefs (Vlaeyen & Linton 2000, Burton *et al* 1999). Whether this also applies to patients with RA needs to be studied. Further studies are also needed to explore cognition in relation to physical activity among patients with RA.

6 CONCLUSIONS

- The 10-week muscle relaxation training with taped instructions exerted a short-term influence on certain aspects of self-rated health and on observed muscle function. More effort should have been made to maintain the training and to integrate the skills into daily life to reach long-term effects.
- The measurement properties of the revised Swedish MHLC-C were generally consistent with the original MHLC-C and the translated version thus possesses satisfactory content validity, construct validity, test-retest stability, and internal consistency for patients with RA. Further investigation of responsiveness and sensitivity to change is needed.
- In patients with early RA, we found relations between moderate/high physical activity and high attribution of health locus of control to health professionals. Relations were also found between high-intensity pain and high internal health locus of control or high attribution of health locus of control to health professionals. No relation between self-rated health and health locus of control was found. Only minor variations in health locus of control relating to age and gender were observed.
- Relationships were found between intensive pain and strong beliefs about a relationship between pain and impairment on one hand, and high fear-avoidance beliefs on the other among patients with long-standing RA. However, no such relations were found between physical activity and PAIRS and fear-avoidance beliefs respectively. Health locus of control was related to neither pain nor physical activity.

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MULTIDIMENSIONAL HEALTH LOCUS OF CONTROL SCALE form C

Instruktioner: Nedan finns ett antal påståenden om *din ledsjukdom*, vilka du kan instämma i eller motsäga. Bredvid varje påstående finns en skala som varierar från "stämmer inte alls" (1) till "stämmer helt" (6). För varje påstående skulle vi vilja att Du ringar in den siffra som bäst motsvarar Din uppfattning. Ju mer Du håller med om ett påstående, desto högre siffra ringar du in. Kontrollera att Du besvarar varje påstående och att Du ringar in bara en siffra per påstående. Det här är ett mått på Dina personliga uppfattningar och det finns därför inga rätta svar.

Arbeta snabbt och fundera inte för länge på varje fråga.

1=STÄMMER INTE ALLS
2=STÄMMER DÅLIGT
3=STÄMMER GANSKA DÅLIGT

4=STÄMMER GANSKA BRA
5=STÄMMER BRA
6=STÄMMER HELT

	SIA	SD	SGD	SGB	SB	SH
1. Om min <i>ledsjukdom</i> förvärras beror det på mig själv hur snart jag blir bättre igen	1	2	3	4	5	6
2. Det kan gå hur som helst med min <i>ledsjukdom</i> , varken jag eller någon annan kan påverka den	1	2	3	4	5	6
3. Om jag träffar min läkare regelbundet, minskar risken för att jag ska få problem med min <i>ledsjukdom</i>	1	2	3	4	5	6
4. Det mesta som påverkar min <i>ledsjukdom</i> sker av en tillfällighet	1	2	3	4	5	6
5. Så snart min <i>ledsjukdom</i> förvärras bör jag kontakta någon inom sjukvården	1	2	3	4	5	6
6. Jag är själv direkt ansvarig för förbättringar och försämringar i min <i>ledsjukdom</i>	1	2	3	4	5	6
7. Det beror till stor del på andra om min <i>ledsjukdom</i> förbättras, är oförändrad eller försämras	1	2	3	4	5	6
8. Vad som än försämrar min <i>ledsjukdom</i> , är felet mitt eget	1	2	3	4	5	6
9. Förbättringar i min <i>ledsjukdom</i> beror till stor del på slumpen	1	2	3	4	5	6
10. Det är andra som ska se till att min <i>ledsjukdom</i> förbättras	1	2	3	4	5	6
11. Det beror till stor del på turen om min <i>ledsjukdom</i> förbättras	1	2	3	4	5	6
12. Det som mest påverkar utvecklingen av min <i>ledsjukdom</i> är vad jag gör själv	1	2	3	4	5	6
13. Det är jag som ska ha äran om min <i>ledsjukdom</i> förbättras och skulden om den försämras	1	2	3	4	5	6
14. Att följa doktors råd till punkt och pricka är det bästa sättet att förhindra att min <i>ledsjukdom</i> förvärras	1	2	3	4	5	6
15. Om min <i>ledsjukdom</i> förvärras beror det på ödet	1	2	3	4	5	6
16. Om jag har tur kommer min <i>sjukdom</i> att förbättras	1	2	3	4	5	6
17. Om min <i>ledsjukdom</i> försämras beror det på att jag inte har skött mig på rätt sätt	1	2	3	4	5	6
18. Den hjälp jag får av andra är avgörande för hur snart min <i>ledsjukdom</i> kan förbättras	1	2	3	4	5	6